The resin from Example 1 was coated directly onto a low carbon steel surface as a primer layer and allowed to cure. The cured coating was then electrically disbonded by the following procedure. A thickened gel comprised of ammonium hexafluoride-exchanged PPODA was spread over the surface of the primer-coating and physically contacted with a conductive element, such as a wire, mesh, foil or grid. Attachment of a 50V power source to the steel surface (anode) and the conductive element (cathode) for a period of less than 20 minutes resulted in anodic disruption of the adhesive bond between the primer and the steel surface.

Example 12. This example describes disbonding of a pigmented coating.

To 100 parts by weight of the material of Example 2, was mixed 65 parts by weight titanium dioxide (rutile) pigment to yield a white paint. This paint can be used to coat aluminum, steel or other metal surfaces. The coating was locally disbonded by contacting a conducting plate, coated with an ionically conducting gel, to the paint surface and attaching the positive pole of a 50-volt power source to the coated substrate and the negative pole of the power source to the conducting plate. After 10-15 minutes, the paint was easily removed from the treated area by light scrapping or peeling.

What is claimed is:

1. An electrochemically disbondable composition having a matrix functionality and an electrolyte functionality, said matrix functionality providing an adhesive bond to a substrate, and said electrolyte functionality providing sufficient ionic conductivity to said composition to support a faradaic reaction at an interface with an electrically conductive surface in contact with said composition,

whereby said adhesive bond is weakened at said interface.

2. The composition of claim 1, wherein said matrix functionality is provided by a polymer.

3. The composition of claim 2, wherein said polymer is selected from the group consisting of epoxies, phenolics, acrylics, melamines, maleimides, and polyurethanes and combinations thereof.

4. The composition of claim 2, wherein said polymer has a variable crosslink density to form regions of low crosslink density having a relatively high ionic conductivity and regions of high crosslink density having a relatively high mechanical strength.

5. The composition of claim 2, wherein said polymer includes coordination sites that are capable of solvating ions and that support the electrolyte functionality of said composition.

6. The composition of claim 5, wherein said coordination sites are selected

from the group consisting of alkoxy moieties, disulfide moieties, thioalkyl moieties, nitrile moieties, and polyvinylidene fluoride moieties and derivatives thereof.

7. The composition of claim 1, wherein said electrolyte functionality is provided in said composition by an electrolyte additive selected from the group consisting of ion solvating molecules, oligomers and polymers, and ionomers.

8. The composition of claim 1 or 7, wherein said electrolyte functionality is localized in regions within said polymer to form a secondary phase with ionic conductivity.

9. The composition of claim 1, wherein said electrochemically disbondable composition is a phase separated material having first regions of substantially matrix functionality and second regions of substantially electrolyte functionality.

10. The composition of claim 9, wherein said first regions comprise a polymer.

11. The composition of claim 10, wherein said polymer is selected from the group consisting of epoxies, phenolics, acrylics, melamines, maleimides, and polyurethanes and combinations thereof.

12. The composition claim 2 or 11, wherein said polymer comprises epoxy.

13. The composition of claim 9, wherein said second regions are selected from the group consisting of ion solvating molecules, oligomers, and polymers and copolymer blocks thereof, and ionomers.

14. The composition of claim 13, wherein said ion solvating molecule is selected from the group consisting of low molecular weight alkoxides, alcohols, alkyl carbonates, cyclic esters, nitriles, amides and ureas.

15. The composition of claim 9, wherein said phase separated material comprises a block or graft copolymer containing non-polar components and components of ionic conductivity.

16. The composition of claim 15, wherein said non-polar component of said block copolymer is selected to have a low affinity for said matrix functionality of said composition to facilitate phase separation.

17. The composition of claim 1, further comprising a reservoir for containing curing or crosslinking agent.

18. The composition of claim 17, wherein the reservoir is selected from the group consisting of zeolites, clays and polymer gels.

19. The composition of claim 1 or 9, wherein said electrolyte functionality includes a salt capable of being solvated into said composition.

20. The composition of claim 19, wherein said salt is selected from the group consisting of alkali metal, alkaline earth and ammonium salts.

21. The composition of claim 19, wherein said salts include an anion selected from the group consisting of hexafluorophosphate, tetrafluoroborate, hexafluoroantimonate and perchlorate.

22. The composition of claim 19, wherein said salt is an ammonium salt and the ammonium cation is immobilized in said composition.

23. The composition of claim 1 or 9, wherein said composition has a ionic conductivity in the range of 10^{-11} to 10^{-5} S/cm^2.

24. The composition of claim 1 or 9, wherein said composition has a ionic conductivity in the range of 10^{-9} to 10^{-7} S/cm^2.

25. The composition of claim 1 or 9, further comprising an additive selected from the group consisting of pigments, corrosion inhibitors, leveling agents, gloss promoters, rubber tougheners and fillers.

26. The composition of claim 1 or 9, wherein said composition is an adhesive.

27. The composition of claim 26, wherein said adhesive composition has a shear strength with a surface of at least 200 psi.

28. The composition of claim 1 or 9, wherein said composition is a coating.

29. The composition of claim 28, wherein said coating is resistant to delamination from a substrate to which it is applied.

30. An electrochemically disbondable composition, comprising:

a curable material having an electrolyte located therein,

wherein said uncured polymeric material, when cured, provides in combination with said electrolyte, sufficient ionic conductivity to support a faradaic reaction at a surface in electrical contact with an electrode.

31. The composition of claim 30, wherein said curable material is selected from the group consisting of epoxy resins, phenolic resins, acrylic resins, melamine resins, malemide resins, and urethanes.

32. The composition of claim 30, wherein the composition phase separates upon curing, said phase separated material having first regions of mechanical strength and second regions of ionic conductivity.

33. A corrosion resistant coating, comprising:

a substrate subject to corrosion; and

a composition having a matrix functionality and an electrolyte functionality, said matrix functionality providing an adhesive bond to said substrate, and said electrolyte functionality providing sufficient ionic conductivity to said composition to support a faradaic reaction at an interface with said

substrate,

whereby corrosion of said substrate does not propagate at said interface.

34. A bonded structure, comprising:

two electrically conductive surfaces; and

a bond between said two surfaces, said bond including:

the electrochemically disbondable composition of claim 1 or 9.

35. The bonded structure of claim 34, wherein at least one of said conductive surfaces is an article to be secured by said bond.

36. The bonded structure of claim 34, wherein at least one of said electrically conductive surfaces comprises a conductive element selected from the group consisting of sheets, foils, grids and meshes.

37. The bonded structure of claim 35, wherein at least one of said electrically conductive surfaces comprises a conductive element selected from the group consisting of sheets, foils, grids and meshes.

38. The bonded structure of claim 36, wherein said conductive element further is bonded to an article using an adhesive.

39. The bonded structure of claim 36, wherein said conductive element further is bonded to an article using the electrochemically disbondable composition of claim 1.

40. The bonded structure of claim 34, wherein at least one of said electrically conductive surfaces is an electrically conductive coating applied to a substrate.

41. The bonded structure of claim 36, wherein at least one of said electrically conductive surfaces is an electrically conductive coating applied to a substrate.

42. A bonded structure, comprising;

first and second electrically conductive surfaces; and

an electrically conductive element disposed there between,

wherein the electrochemically disbondable composition of claim 1 is used to bond said electrically conductive element to said first and second conductive surfaces.

43. A laminate structure, comprising:

first and second electrically conductive elements selected from the group consisting of foils, sheets, meshes and grids; and

the disbondable composition of claim 1 or 9 disposed therebetween and bonded to said first and second elements.

44. A method of disbonding a composition from an electrically conductive surface to which it is bonded, comprising:

providing a first electrically conductive surface treated with an electrochemically disbondable composition having a matrix functionality and an

electrolyte functionality, said matrix functionality providing an adhesive bond to said first conductive surface, and said electrolyte functionality providing sufficient ionic conductivity to said disbondable composition to support a faradaic reaction at an interface of said first conductive surface and said disbondable composition;

contacting a second electrically conductive surface to said disbondable composition; and

applying a voltage across said disbondable composition to cause a faradaic reaction at said first conductive surface, whereby the bond to said first conductive surface is weakened.

45. The method of claim 44, further comprising:

removing said disbondable composition from said first conductive surface.

46. The method of claim 44, wherein said composition is a coating.

47. The method of claim 44, wherein said second electrically conductive surface is an ionically conductive gel.

48. The method of claim 47, whereby said coating in contact with said electrically conducting gel is selectively removed.

49. The method of claim 44, wherein said composition is an adhesive.

50. The method of claim 44, wherein said disbonding occurs at the anodic

interface.

51. The method of claim 44, wherein disbonding occurs at the cathodic interface.

52. The method of claim 44, wherein disbonding takes place at said first and second electrically conductive surfaces.

53. The method of claim 52, wherein an alternating current is applied to said disbonding composition.

54. The method of claim 52, wherein a voltage is applied in a first electrical circuit to disbond at the first electrically conductive surface; and thereafter polarity of the circuit is reversed and an electrical voltage is applied to disbond the composition at the second electrically conductive surface.

55. The method of claim 52, wherein the first and second electrically conductive surfaces are electrically connected in parallel to a power source and voltage is applied is applied between the first and second electrically conductive surfaces and a third electrically conductive surface in contact with the disbondable composition.

56. The method of claim 44, further comprising:

monitoring the current at an ammeter in series with the structure and stopping the applied voltage once current has been reduced by a predetermined

amount.

57. The method of claim 45, further comprising:

contacting said disbondable composition and/or said first conductive surface including residual disbondable composition with a solvent capable of ion solvation to solvate said electrolyte functionality of said disbondable composition, whereby said disbondable composition is removable from said surface.

58. The method of claim 57, wherein said solvent is selected from the group consisting of low molecular weight alcohols.

59. A method of removing a composition from a substrate, comprising:

contacting a surface treated with an electrochemically disbondable composition having a matrix functionality and an electrolyte functionality, said matrix functionality providing an adhesive bond to said surface, and said electrolyte functionality providing sufficient ionic conductivity to said disbondable composition to support a faradaic reaction at an interface of said first electrically conductive surface and said disbondable composition, with a solvent capable of ion solvation,

whereby ions of said electrolyte functionality are solvated; and

removing said composition from said surface.